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ABSTRACT

This document contains a summary of the 1974-75 statewide assessment for mathematics education in Louisiana. The study involved samples of students at ages 9, 13, and 17. Chapter 1 presents planning, development, and administration. Chapter 2 presents results of the assessment and Chapter 3 presents conclusions and recommendations. Content areas needing emphasis for each age group are identified. Recommendations for inservice education are also suggested. Many figures are used to summarize data. (RH)

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MATHEMATICS HIGHLIGHTS REPORT

1974-75

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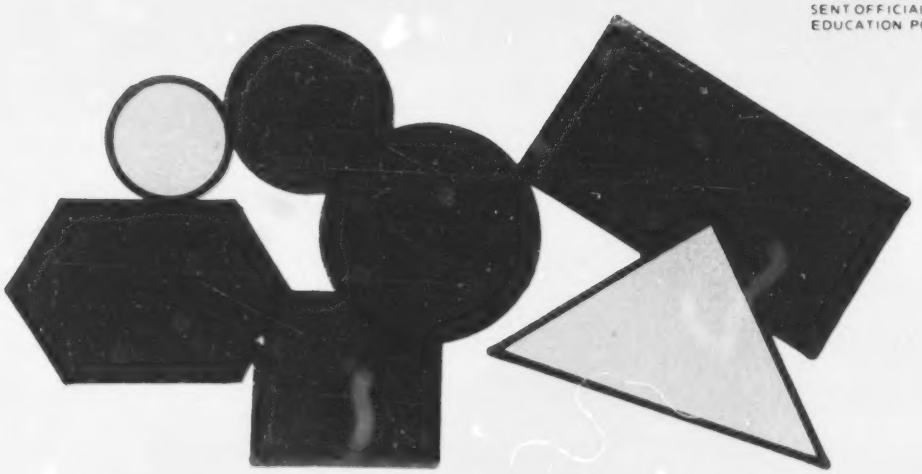

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Superintendent J. Kelly Nix

Louisiana State Department of Education

LOUISIANA
STATE DEPARTMENT OF EDUCATION

1976

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MATHEMATICS HIGHLIGHTS REPORT
1974-75

Prepared by
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J. Kelly Nix, Superintendent

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MATHEMATICS HIGHLIGHTS REPORT

INTRODUCTION

EDUCATIONAL ASSESSMENT AND LOUISIANA

In 1973 the Louisiana State Department of Education initiated a program to gather information on the knowledge, skills, and attitudes of sample groups of public school children in all educational subject areas. Before this date, Louisiana could boast of no achievement testing program or of any other means of gathering knowledge about classroom progress. The establishment of the assessment program represented a major step toward improved accountability for the state's elementary and secondary schools. Since a basic goal of the State Department is to effect qualitative improvements in our schools, particularly in the areas of curriculum and instruction, an educational assessment, with its unique ability to pinpoint areas of strength and deficiency, offers the most effective way to diagnose curricular ills and to suggest necessary remedies.

The Louisiana Assessment program was modeled after the National Assessment of Educational Progress (NAEP), a project of the Education Commission of the States which began in 1969.

The major goals of the national program are twofold: to make available the first census-like data on the educational attainments of young Americans; and to measure any growth or decline that takes place in selected aspects of educational attainments of young Americans in certain subject areas. The NAEP program is now into its second cycle of assessment, as Figure 1 indicates:

Figure 1

NAEP Assessment Cycle

CYCLE 1	
March, 1969 - February, 1970	Science, Writing, Citizenship
October, 1970 - August, 1971	Reading, Literature
October, 1971 - August, 1972	Music, Social Studies
October, 1972 - August, 1973	Math, Science (Second Assessment)
October, 1973 - August, 1974	Writing (Second Assessment), Career & Occupational Development
October, 1974 - August, 1975	Citizenship (Second Assessment), Art

CYCLE 2	
October, 1975 - August, 1976	Reading, Literature (Second Assessment)
October, 1976 - August, 1977	Music, Social Studies (Second Assessment)
October, 1977 - August, 1978	Math (Second Assessment), Science (Third Assessment)
October, 1978 - August, 1979	Writing (Third Assessment), Career & Occupational Development (Second Assessment)
October, 1979 - August, 1980	Citizenship (Third Assessment) Art (Second Assessment)

Until the National Assessment was begun, billions of dollars were being spent on education in the United States--on buildings, on teacher salaries, on curriculum planning--but very little was known about the effectiveness of this expenditure. National Assessment was conceived as a device for gathering information that will help legislators, educators, and other decision-makers in the overall objective of improving the educational experience of America's youth. It is the first and only effort to obtain dependable and complete achievement data from school population groups on a national basis in a uniform, scientific manner. The goals of the Louisiana Assessment program differ only in their geographic scope.

The first statewide assessment during the 1973-74 school year was conducted in the area of reading, and the results of that assessment have been published.[1] With a view toward amassing data on all instructional areas taught in the schools, mathematics and social studies were assessed during 1974-75. This document contains a summary of the results in mathematics.

A clear understanding of the meaning and goals of assessment is required in order to interpret the information contained

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[1] State Department of Education of Louisiana: 1974, Louisiana Reading Assessment, 1973-74 School Year, Detailed Results Report, Bulletin 1410.

herein. There is some confusion caused by the use of the term "assessment" in other contexts. In the minds of most laymen, the term is associated with property and taxes. Both educational and property assessment focus on evaluation. But while the latter evaluates real estate, the former concentrates on the minds of young people.

In the field of education, assessment must be distinguished from other kinds of testing and measurement. Some of its unique features are the following:

1. Assessment is not the common achievement testing program using standardized tests where individual performance is measured according to how other pupils performed. In this process students are ranked according to norms: thus, if Mary scored at the 18th percentile, and George at the 50th, George would obviously rank higher than Mary on the particular test, but we would have no indication of what each actually knew on the subject.
2. The assessment instrument, designed to measure knowledge and skills, is criterion-referenced, that is, pupil performance is

measured according to criteria (goals and objectives) established by experts in the subject field for each particular age level.

3. Nationally and in the state of Louisiana, those to be assessed are selected on the basis of a scientifically developed sample which insures a high degree of statistical accuracy. Each student is randomly selected from all eligible students attending the school, and each has an equal chance of being chosen.

4. Assessment uses age levels--9-, 13-, and 17-year-old, rather than grade or some other benchmark. These ages were selected because they are critical periods during the student's progress through the school system.

5. The assessment instrument is administered in schools selected according to the sample design. Pupils complete the instrument under carefully controlled conditions which insure a high degree of objectivity and uniformity. In Louisiana, for example,

24 well-trained former educators conduct the assessment in a systematic fashion.

6. Although the assessment yields a body of data which shows what students actually know compared to what they should know, it performs a second valuable function. By cyclical retesting in all subject areas, a profile may be secured of progression by pupils at each grade level. This profile will reflect the effectiveness of established programs and highlight deficiencies in instruction and curriculum.

Figure 2 shows the schedule for the Louisiana Assessment program, which is subject to change as new and different needs arise. The goals of the program are several:

1. To inform the public about the state of teaching and learning in specific content areas.
2. To improve the course content of inservice workshops and institutes sponsored by the Department.
3. To furnish data for use in the revision of teacher certification standards.

4. To give committees on textbook adoptions information as to our needs.
5. To encourage local participation in assessment studies.
6. To provide data in support of legislative action needed to correct identified educational weaknesses.
7. To assist those federal programs which require needs assessment.
8. To provide research materials for the state's colleges and universities.
9. To provide concrete data about teaching and learning for use by educational master planners.

FIGURE 2

Louisiana Assessment of Educational Progress

ASSESSMENT CYCLE

YEAR	SUBJECT AREA
1973-74	Reading
1974-75	Social Studies Mathematics
1975-76	Career and Occupational Development
1976-77	Science
1977-78	Reading Literature
1978-79	Music Writing

CHAPTER I

THE MATHEMATICS ASSESSMENT: PLANNING, DEVELOPMENT, AND ADMINISTRATION

After the decision was made to conduct an assessment in mathematics, the first step in the planning process was the establishment of the goals and objectives, the criteria for the assessment instrument. A list of the possible objectives of mathematics teaching at the 9-, 13-, and 17-year age levels was compiled in survey form and sent to over 600 mathematics teachers and supervisors throughout the state. They were asked to rate the objectives on a five-point scale in order of importance. The survey resulted in the establishment of five major objectives of mathematics instruction in the state, as follows:

Objective I	Recall and/or recognize definitions facts, and symbols
Objective II	Perform mathematical manipulations
Objective III	Understand mathematical concepts and processes
Objective IV	Solving mathematical problems--social, technical, and academic

Objective V — Using mathematics and mathematical reasoning to analyze problem situations, define problems, formulate hypotheses, make decisions, and verify results

The objectives have been published and are available upon request.[1]

To assist the program staff, an advisory council was appointed in the spring of 1974. It was composed of teachers, supervisors, university professors, and interested laymen. Such councils are an integral part of assessment programs at the national and state levels because such programs are committed to the principle of fullest public involvement in the process by which the state of learning in the schools is determined. The councils also provide an effective way to inform taxpayers who support the educational process about progress in the schools. The advisory council in mathematics (see Appendix 1) worked with the assessment staff in the selection of items for the instrument or test booklet. Approximately one-third of the test items were gleaned

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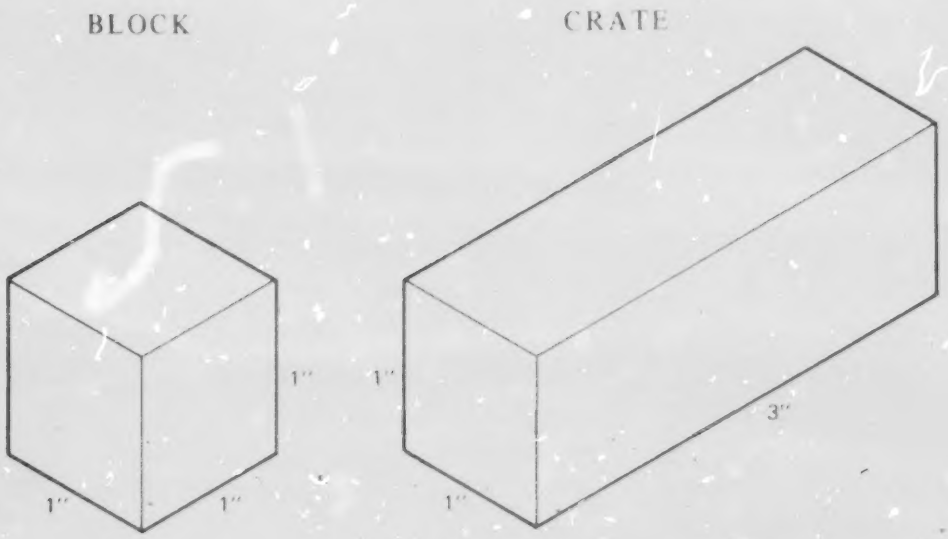
[1] State Department of Education of Louisiana: 1974, Establishing Objectives Pursuant to Conducting a Mathematics Assessment in Louisiana, Bulletin 1268.

from National Assessment tests, in order to facilitate regional (southeast) and national comparisons. Figure 3 shows a typical page from the mathematics booklet for 13-year-olds. Note that it is designed to be scored by machine because of the large numbers in the sample.

Figure 3

60. Look at the pictures below. How many blocks does it take to fill the crate?



- ○ 2
- ○ 3
- ○ 5
- ○ 6

- ○ I don't know.

61. Which of the following is the closest approximation to 1 mile?

- ○ 1 meter
- ○ .62 meters
- ○ 1.6 kilometers
- ○ 4 kilometers

- ○ I don't know.

62. Suppose $\frac{x}{y}$ represents a number. If the values of x and y are each doubled, the new number is

- ○ $\frac{1}{2}$ as large as $\frac{x}{y}$.
- ○ equal to $\frac{x}{y}$.
- ○ double $\frac{x}{y}$.

- ○ I don't know.

STOP DO NOT CONTINUE UNTIL TOLD TO DO SO.

An ideal assessment would include every child in the state at each age level. But economic and temporal limitations precluded such a "census" assessment in favor of a stratified random sample consisting of 15,000 students, 5,000 at each age level. The sample was designed to be an accurate representation of the actual school population in all respects within the eight planning regions in the state (see Figure 9) as well as in the state as a whole. It was constructed to insure that schools from each parish were included in at least one age level assessment. A total of 390 schools in the state were used in the assessment. The sample was designed in such a way as to insure that the study would be as free of bias and scientifically objective as humanly possible. Thus within the limits of a small standard error, if the black-white ratio in a given region is 55 percent to 45 percent, the same ratio persists in the assessment sample, and the sample would be true for religious or any other educationally significant kind of grouping.

The actual administration of the assessment took place during 1974-75 in accord with the National Assessment model: 13-year-olds in October, 9-year-olds in January, and 17-year-olds in March. The Louisiana program employed 24 retired school teachers and administrators who were called exercise administrators and who actually gave the assessment in the

schools. The assessment used paced tape administration; that is the whole booklet was recorded by a professional announcer, and the tape was played in the classroom so that the child heard the questions as he read them. Such procedure not only assured uniformity of administration, it also minimized the effect of differences in reading ability, thereby increasing reliability of the mathematics assessment.

The analysis phase of the assessment process began soon after the first booklets were scored by Westinghouse Learning Corporation. The actual processing of the data and sample design was performed by Research Triangle Institute of North Carolina, under contract with the State Department. To provide some indication of the complexity of the analysis task, Figure 4 represents an actual page from the computer printed results on a single mathematics item. You will note here not only the percentage knowing the correct response but also the reporting variables: i.e., other factors, such as region within the state, community type, school size, and sex, which seem to have a direct bearing on performance. The other three categories of the page concern a survey conducted as a part of the assessment.

LOUISIANA EDUCATIONAL ASSESSMENT, YEAR 02
MATHEMATICS ITEM RESULTS, SEVENTEEN YEAR OLDS

LaAEP Exercise LME201 Measurement Inches OBJECTIVE II E

Percent Correct	Standard Error of %	State Effect	Standard Error of Effect	Sample Size		Percentage Correct 0 10 20 30 40 50 60 70 80 90 100
85.77	0.99			3085	Louisiana	
					REPORTING GROUPS:	
					REGIONS	
86.07	2.14	0.29	2.01	355	Region I	
84.26	1.91	-1.51	1.75	423	Region II	
85.52	2.05	-0.25	2.12	377	Region III	
88.22	2.19	2.44	2.11	355	Region IV	
90.58	1.38	4.81*	1.61	401	Region V	
87.81	2.03	2.04	2.16	393	Region VI	
86.37	2.10	0.60	1.89	364	Region VII	
79.38	4.43	-6.39	3.85	417	Region VIII	
					COMMUNITY TYPE	
85.78	1.23	0.01	1.08	1005	Large City	
92.71	1.16	6.94*	1.34	437	Suburban	
88.60	1.82	2.83	1.78	565	Small City or Town	
81.88	2.21	-3.89*	1.62	1078	Rural	
					SCHOOL SIZE	
82.09	2.77	-3.68	2.30	959	800 or less	
87.89	2.02	2.12	1.87	853	801 - 1199	
86.73	1.43	0.96	1.34	1273	1200 or greater	
					SEX	
86.78	1.15	1.00	0.79	1445	Male	
84.95	1.28	-0.82	0.64	1640	Female	
					QUALITY OF MATH PROGRAM	
78.81	3.44	-5.97*	3.26	487	Limited	
80.02	3.18	-5.76*	2.74	559	Adequate	
89.33	0.97	3.56*	0.94	1868	Superior	
					CURRICULUM GUIDE USED	
84.30	1.19	-1.47*	0.53	2154	Yes	
89.99	1.44	4.22*	1.35	662	No	
					BASIC MATH COURSE	
75.62	2.17	-10.16*	2.19	697	Yes	
89.06	1.26	3.29*	0.66	2357	No	

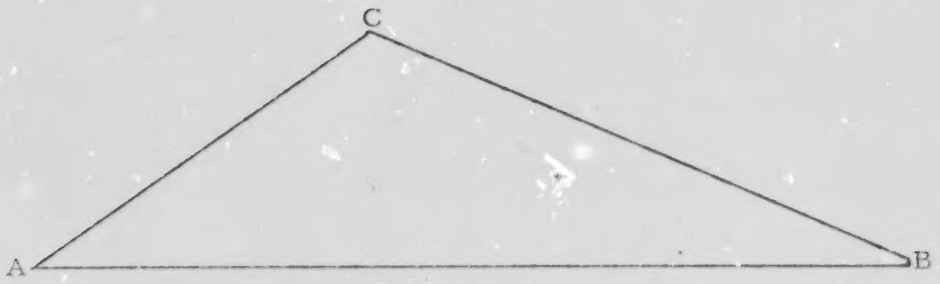
Figure 4

Figure 5 is the actual item which produced these results. In the upper left-hand corner of the figure are the words identifying the booklet. In the middle at the top is the abbreviation which indicates that the multiple choice item was written by the Louisiana advisory council. The words and numbers in the upper right-hand corner indicate that the item was used at all three age levels in the assessment, a practice which, as will be seen later, yields some invaluable information about what is actually being learned. In the middle of the figure is the actual item, one part of which, having to do with measurement in centimeters, has been omitted. In effect the youngster was asked to use a ruler to measure line AB, and the percentage responding correctly (85.8%) is shown. In the lower left-hand corner are the goal and content areas the item measures.

Figure 5

MATHEMATICS--SEVENTEEN-YEAR-OLD (LA) OVERLAP 9, 13

GOAL II (PART A)



56. Look at your ruler. On the inch scale the numbers are far apart. The centimeter scale is the one where the numbers are closer together.

A. Using the inch scale on your ruler, measure the line segment AB. The length is

9.2% ○ 6 inches.
1.8% ○ $2\frac{1}{2}$ inches.
85.8% ● 5 inches.
○ 1.1% $4\frac{1}{2}$ inches.

○ 1.9% I Don't Know.

GOAL: PERFORM MATHEMATICAL MANIPULATIONS
CONTENT: ESTIMATION AND MEASUREMENT SAMPLE - ITEM REPORTING PAGE

In Figure 5, the "P-value" (percentage responding correctly) is 85.8 percent. Thus, according to the educators who composed the test item, 85.8 percent of 17-year-olds could answer this question, although, ideally, all 17-year-olds in the state should have reached the level of mathematical sophistication necessary to respond properly. Consistently low P-values indicate areas of weakness. The total P-value for each age-level is the comparative agent through which results in the following chapters were computed.

CHAPTER II

THE MATHEMATICS ASSESSMENT: RESULTS

Although the assessment revealed a large body of useful information, several caveats should be considered in its application. The Louisiana educational environment is affected by two unusual circumstances. First, there is an exceptionally large incidence of private education in the state, about 150,000 out of a million children, or 15 percent. This sizeable minority of students was not involved in the public schools assessment, although it is a factor in total educational quality. A second affective agent is the dropout rate. This can be expected to improve the performance level of Louisiana students, especially in the upper age levels, in comparison with the national average for two reasons: first, this state's dropout rate is higher than the national average;[1] secondly, that percentage which drops out can be considered the poorest overall performers.

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[1] Louisiana's dropout rate is 2.2 percent, or approximately 22,000 per year, according to "School Dropouts in Louisiana 1974-75." The comparable national figure, as derived from the "U.S. Digest of Educational Statistics," is 1.0 percent.

A comparison between Louisiana students' achievement and that of other children in the nation is revealing. Figure 6 illustrates 9-year-old performance abilities in each of the five mathematics objectives outlined in Chapter I. Although Louisiana 9-year-olds score slightly higher than others in the southeastern region of the country,[2] they fall below the national achievement level. Particularly poor results are evident in their failure to perform mathematical manipulations and to use mathematical training as a basis for logical behavior.

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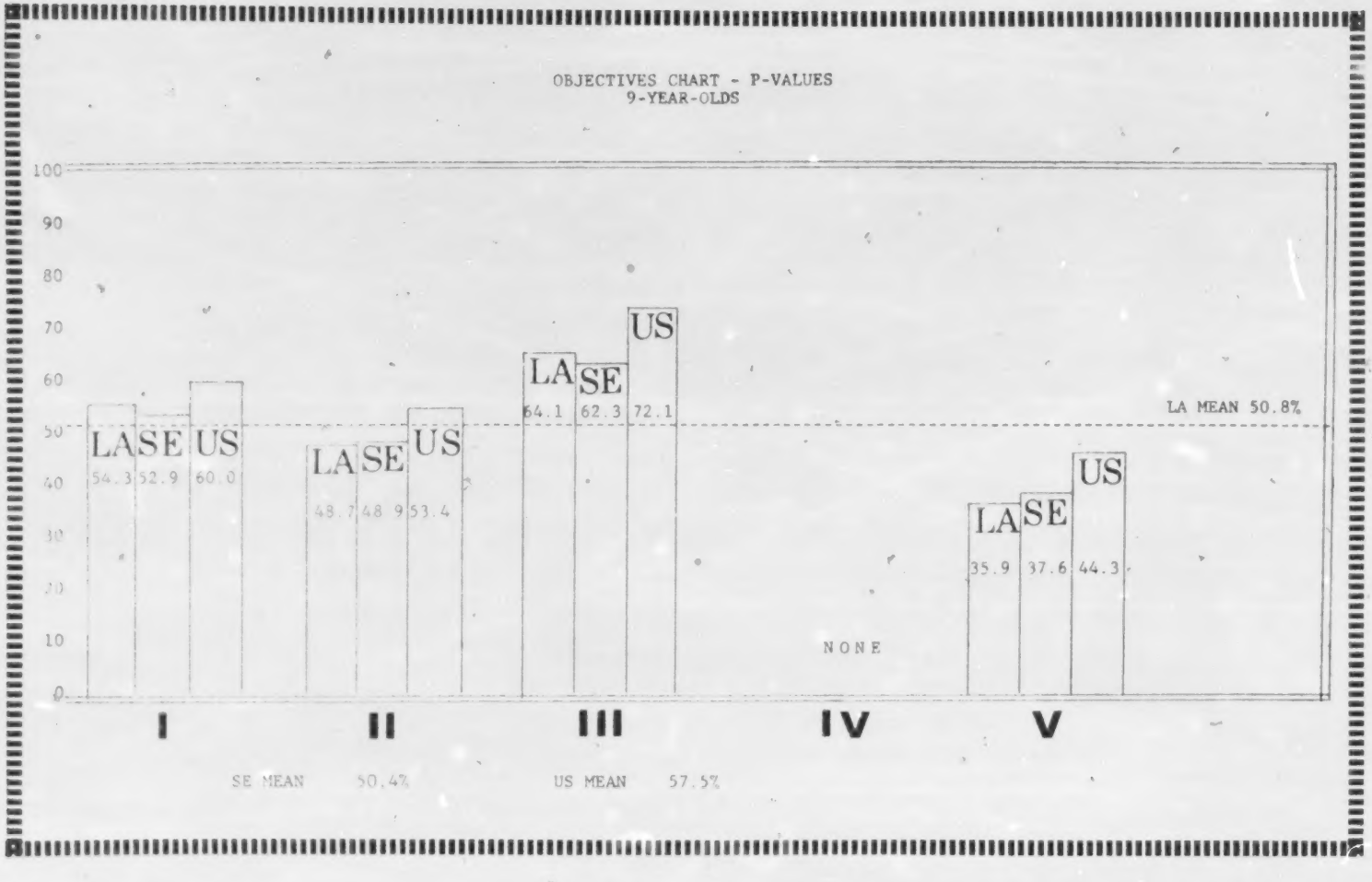
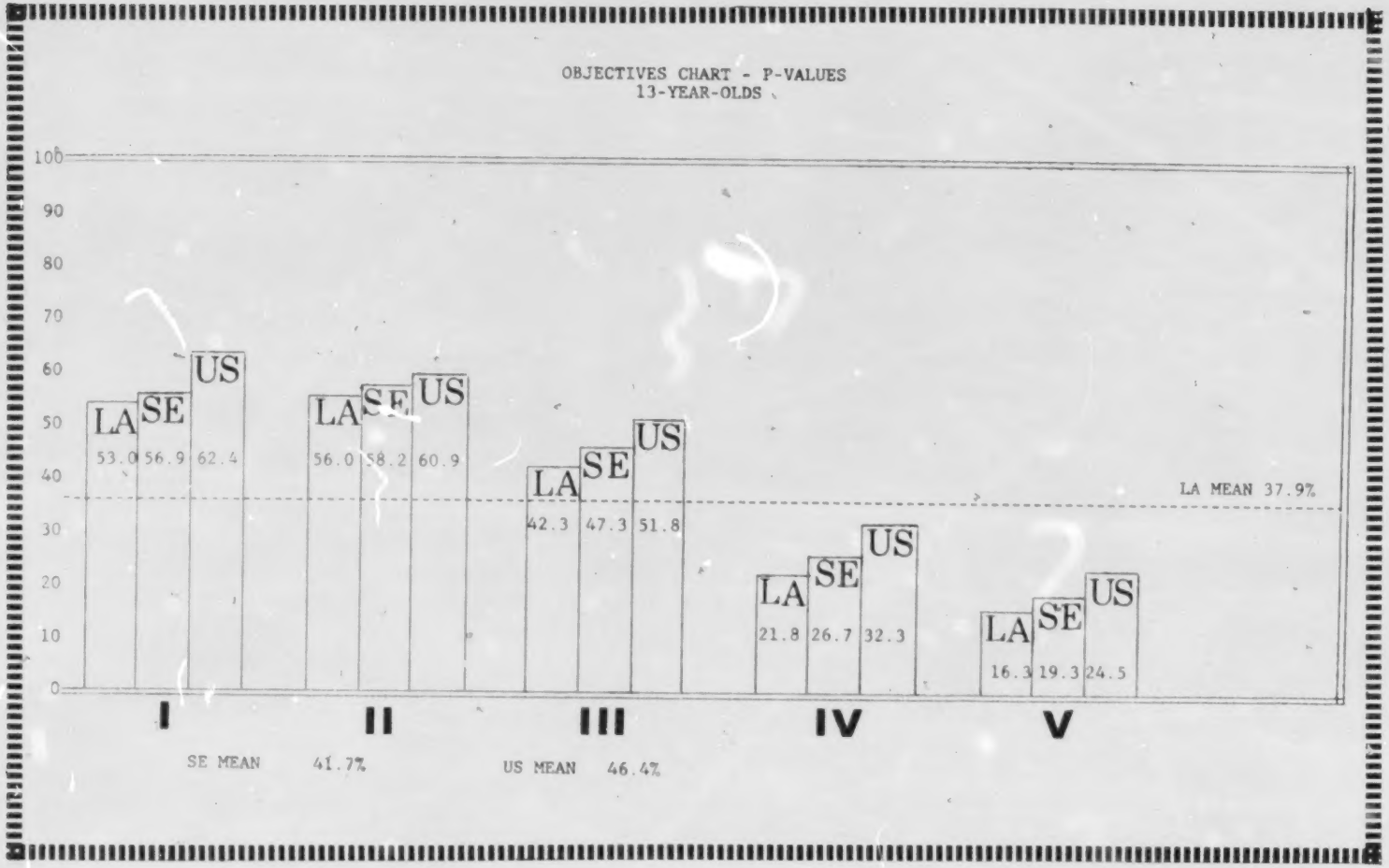
[2] The southeastern region consists of the following states: Alabama, Arkansas, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, West Virginia, and Louisiana.

Figure 6


OBJECTIVES CHART - P-VALUES
9-YEAR-OLDS
100
90
80
70
60
50
40
30
20
10
0
LA SE US
54.3 52.9 60.0
LA SE US
48.7 48.9 53.4
LA SE US
64.1 62.3 72.1
NONE
LA SE US
35.9 37.6 44.3
LA MEAN 50.8%
I
II
III
IV
V
SE MEAN 50.4%
US MEAN 57.5%

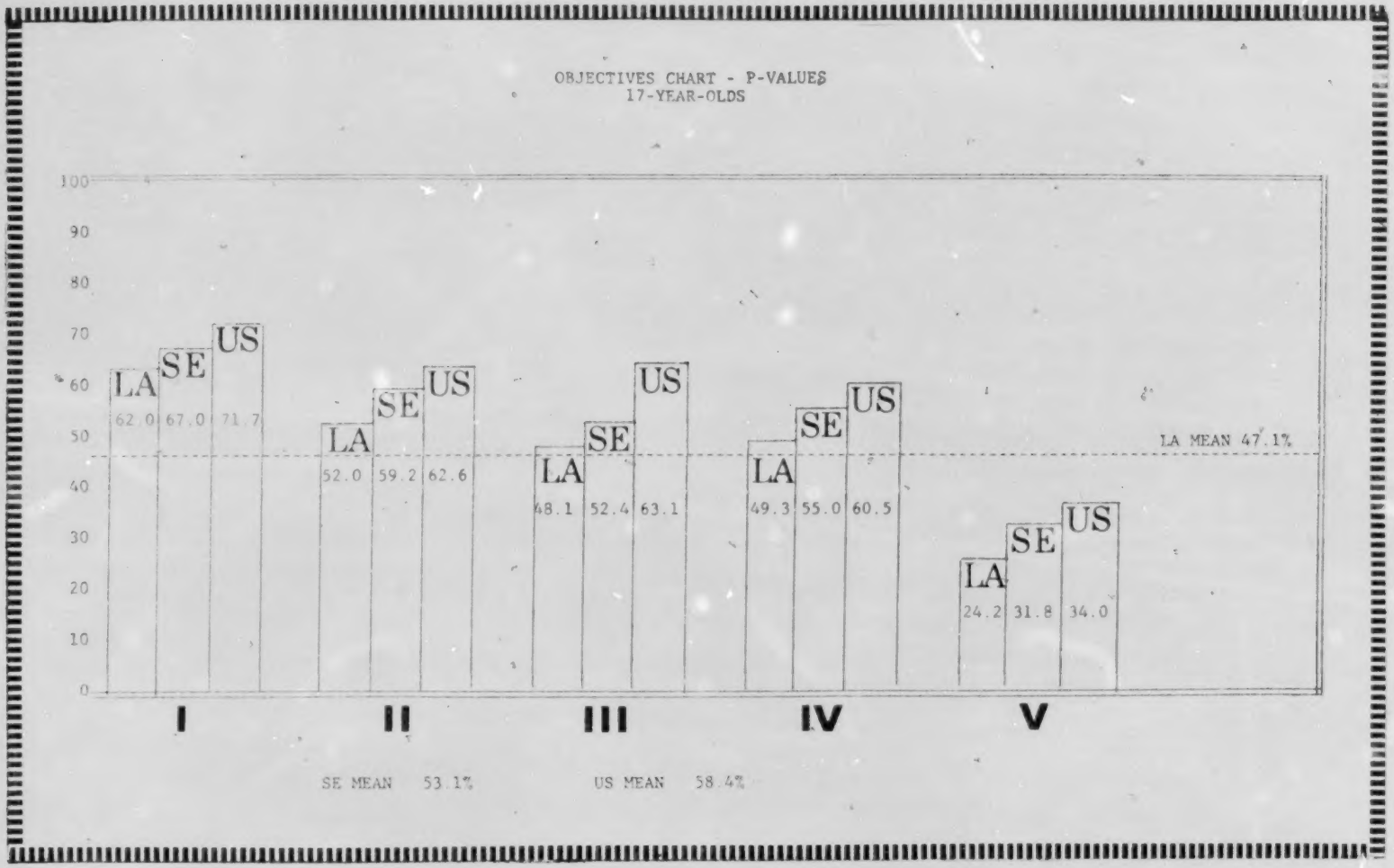
Thirteen-year-olds in the state show a greater decline from the national norm than do 9-year-olds. In every objective, Louisiana students trail the national mean. Also disturbing is the fact that they now are being outpaced by other children in the southeastern region. Their greatest deficiencies lie in solving mathematical problems and, again, in extrapolating their training to logical application.

Figure 7


OBJECTIVES CHART - P-VALUES
13-YEAR-OLDS
100
90
80
70
60
50
40
30
20
10
0
LA
SE
US
53.0
56.9
62.4
56.0
58.2
60.9
42.3
47.3
51.8
21.8
26.7
32.3
16.3
19.3
24.5
LA MEAN 37.9%
I
II
III
IV
V
SE MEAN 41.7%
US MEAN 46.4%

Louisiana students nearing graduation demonstrate the greatest decline in relative performance, despite a higher drop-out rate. The gap between the state and the nation, present in the preceding two graphs, increases to a chasm for 17-year-olds, as revealed in Figure 8. Further, the southeastern region draws farther ahead of the state at this age. As was true with the 13-year-olds, our 17-year-olds perform more poorly on all objectives.

Figure 8


OBJECTIVES CHART - P-VALUES
17-YEAR-OLDS
100
90
80
70
60
50
40
30
20
10
0
LA
SE
US
62.0
67.0
71.7
52.0
59.2
62.6
48.1
52.4
63.1
49.3
55.0
60.5
24.2
31.8
34.0
LA MEAN 47.1%
I
II
III
IV
V
SE MEAN 53.1%
US MEAN 58.4%

The comparisons among Louisiana, the southeastern region, and the nation, then, portray an initial disparity which grows larger as students progress through the system. Further, they indicate that the objective of inducing logical reasoning from mathematical comprehension is not being met.

The assessment was designed to do more than compare Louisiana to other geographic entities. It also provides a breakdown of education within the state. Figure 9 illustrates the division of Louisiana into eight geographic regions. Comparison among these regions pinpoints weaknesses in mathematics achievement.

FIGURE 9

STATE OF LOUISIANA

GOVERNOR'S PLANNING REGIONS

As revealed by the regional graphs in Figures 10, 11, and 12, there are considerable differences in mathematical attainment in the state, although no simple geographic trends emerge. Regions IV and V consistently excel at all age levels, while regions I and VIII show generally inferior scores. But, while region I students demonstrate improvement in the high school levels, region VIII shows a consistent decline. Region III shares this pattern of retrogression.

The regional breakdowns defy explanation of variance based on a rural-urban model. Region VIII is largely rural, while region I is overwhelmingly urban, yet both share substandard mathematics performance.

The situation is clarified somewhat by an analysis based on community size.[3] As the graphs in Figures 10, 11, and 12 outline, large city and rural environments discourage mathematical progress, while suburbs and small town situations encourage it. Especially disadvantageous performance is turned in by 17-year-olds in rural schools (Figure 12), who trail some 14 percentage points behind those in suburban settings.

---

[3]There were four types of community: City - Schools located within the corporate limits of the following: New Orleans, Metairie, Baton Rouge, Lafayette, Lake Charles, Alexandria, Monroe, and Shreveport; Suburban - Schools located in residential or commuter communities adjacent to a city; Town - Schools in communities with populations falling between 5,000 and 35,000 and not considered suburban communities; Rural - A community or small town located in a rural environment, population of less than 5,000.

FIGURE 10

TOTAL MATHEMATICS PERFORMANCE
LOUISIANA 9-YEAR-OLDS
(Vertical line represents Louisiana mean)

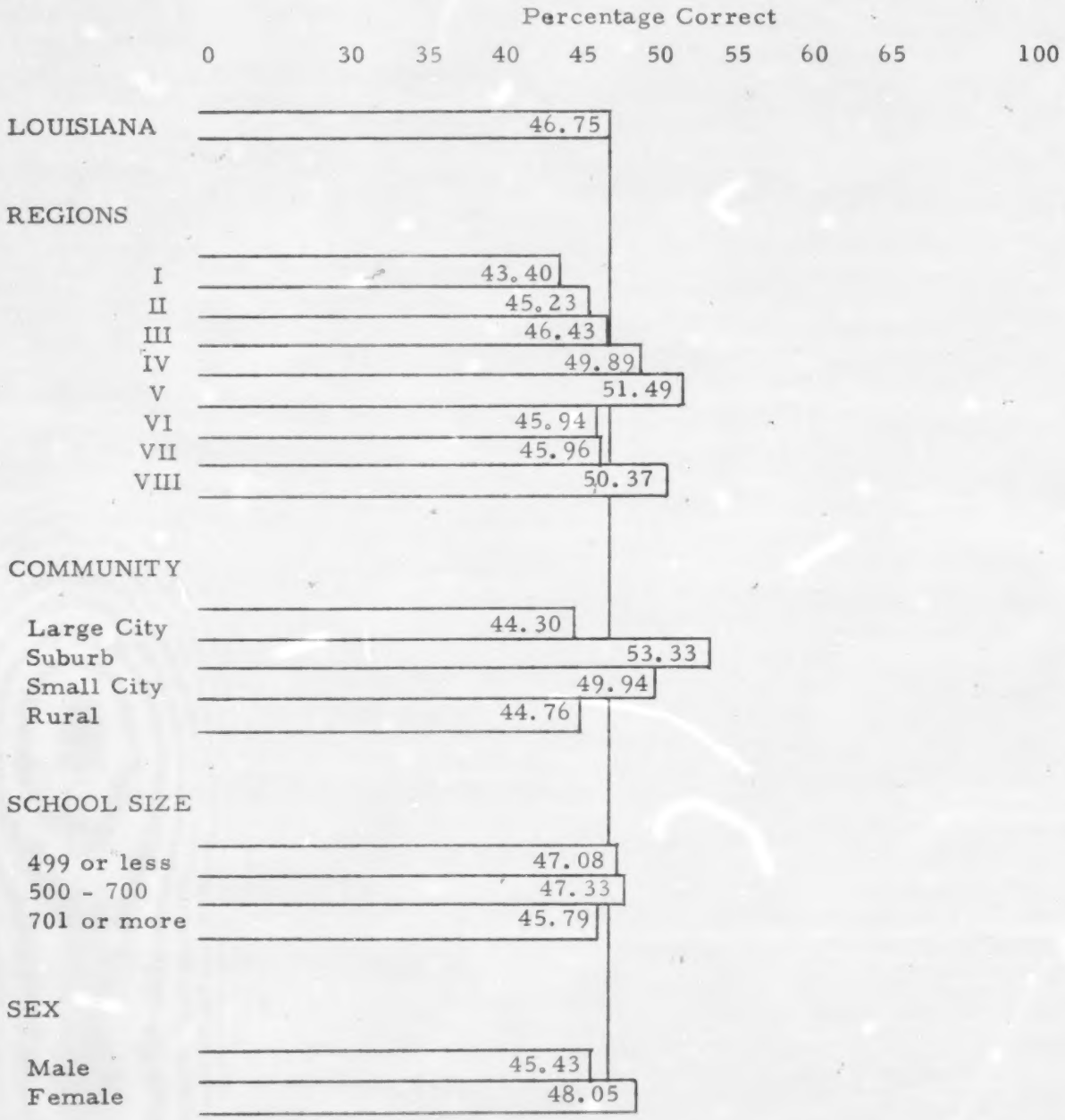


FIGURE 11

TOTAL MATHEMATICS PERFORMANCE
LOUISIANA 13-YEAR-OLDS
(Vertical line represents Louisiana mean)

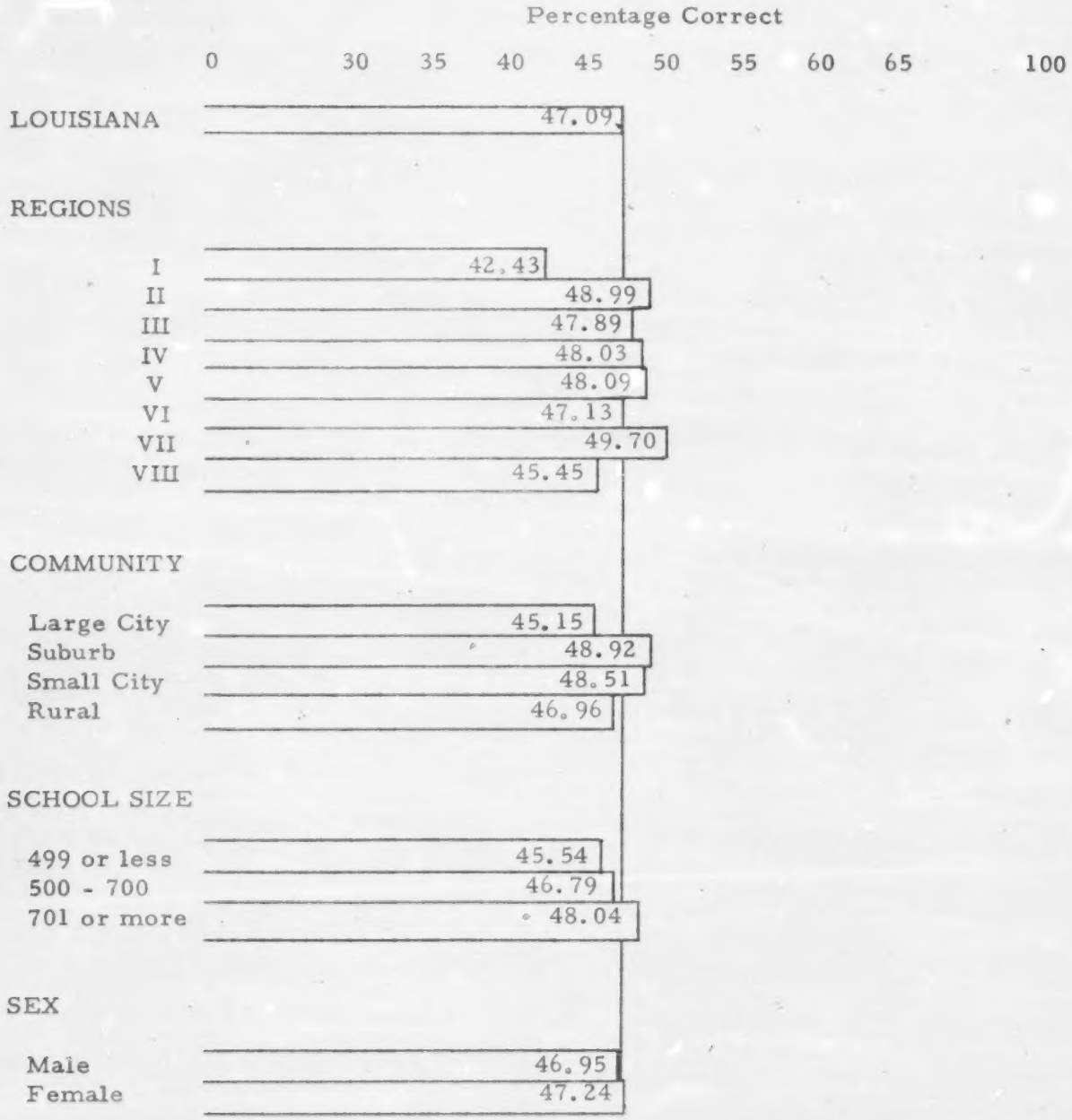
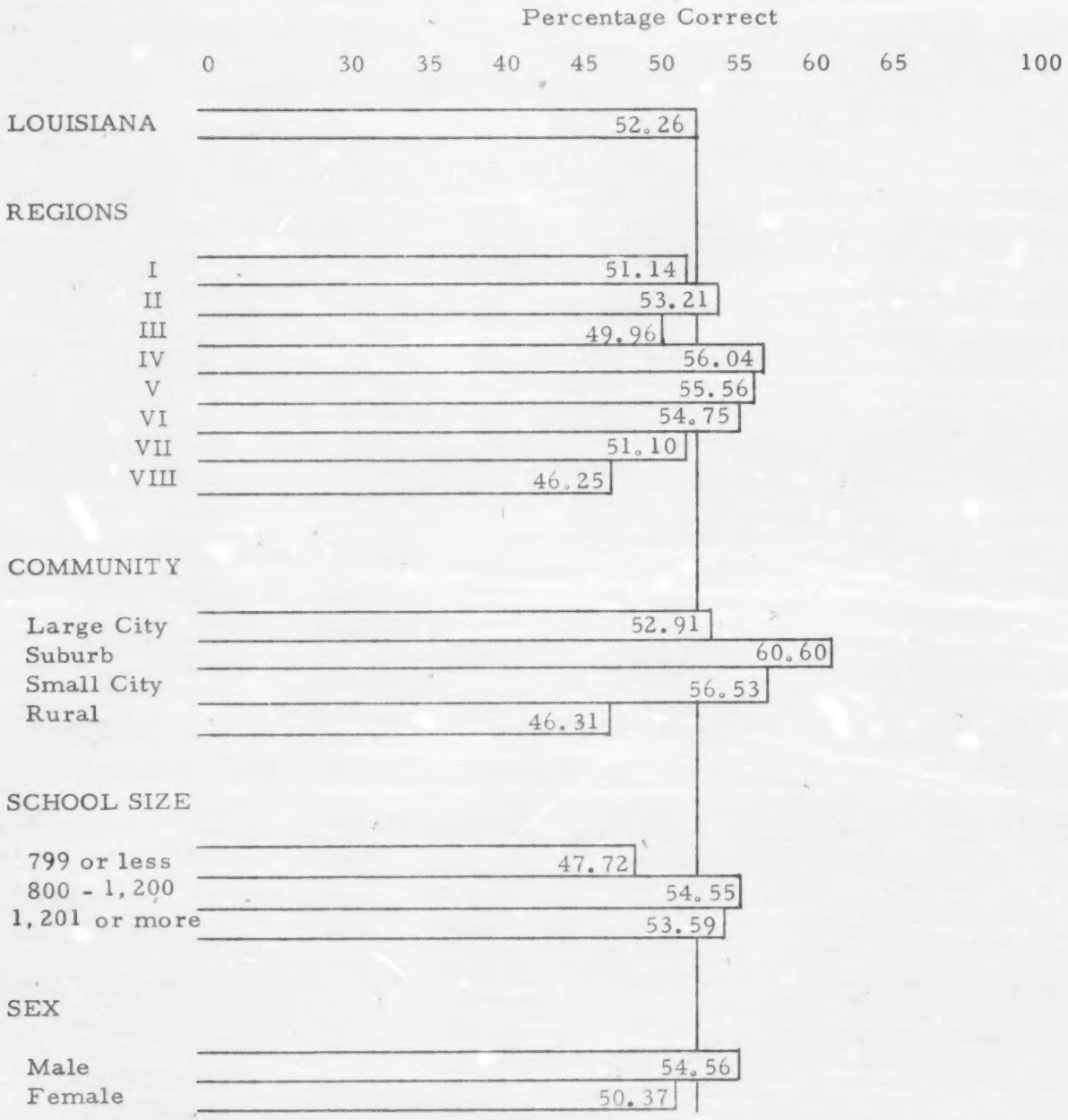


FIGURE 12

TOTAL MATHEMATICS PERFORMANCE
LOUISIANA 17-YEAR-OLDS
(Vertical line represents Louisiana mean)



Tied to community type is the size of school. With some exceptions school size reflects community size. Therefore, one expects, and finds, a relatively better performance by students in moderate sized schools. While elementary-aged children seem penalized by large schools, the reverse holds for 17-year-olds, who do not find the larger plants and greater numbers so intimidating.

A final variable is the sex of the participants. As the charts indicate, the girls initially outperform the boys in mathematical operations. By age 13, male achievement is on a par with females; by age 17, the males have reversed the females' lead and have surged ahead. This pattern can be attributed to the growing influence of sex typing in the later school years.

Comparisons inform us about relative performance, but they tell us little about the real mastery which students should have in the mathematics domain. Just how much do Louisiana students know and how does that knowledge increase with time? The following examples illustrate some of the abilities and limitations of students at each age level. Additionally, footnoted items reveal progress in the various aspects of mathematics. These are overlap questions which are directed toward students

at two age levels, or toward all three assessment ages. A comparison of Figures 13, 14, and 15 discloses percentage progress for identical items. Figure 13 for instance, reveals that 62 percent of 9-year-olds have mastered basic addition. Figure 14 shows the comparable figure for 13-year-olds to be 93 percent, while Figure 15 demonstrates that 96 percent of the 17-year-olds are conversant with simple addition. A mention should be made of the arbitrariness of assigning an item to the "strengths" or "weaknesses" column. Although any item correctly answered by 50 percent of the respondents was considered a strength, a score near 50 percent might just as logically be viewed as a weakness, since a sizeable minority has responded incorrectly.

Figure 13

9-YEAR-OLD MATHEMATICS PERFORMANCE

A. Strengths

$^{\phi}$1. Sixty-two percent (62%) of 9-year-olds could correctly add 19 + 38.

$^{\phi}$2. Fifty-three percent (53%) could use a ruler to measure inches and forty-eight percent (48%) could use a ruler to measure centimeters.

$^{\phi}$3. Fifty-eight percent (58%) could add a column of four monetary sums.

$^{\theta}$4. Seventy percent (70%) could identify the greater of two whole numbers.

$^{\theta}$5. Eighty-eight percent (88%) understand the function of zero in addition; seventy-seven percent (77%) could understand the function of zero in multiplication; and seventy-six percent (76%) understand the function of zero in subtraction.

$^{\theta}$6. Sixty-seven percent (67%) could identify the place value of hundreds, tens, and ones.

$^{\phi}$Overlap item, 9-, 13-, and 17-year-olds.

$^{\theta}$Overlap item, 9- and 13-year-olds.

7. Sixty-three percent (63%) could add two nickels, one quarter, and four pennies.

8. Fifty-six percent (56%) know which odd number follows the sequence 1, 3, and 5.

9. Sixty-four percent (64%) understand the commutative property of multiplication.

B. Weaknesses

$^{\phi}$1. Sixty-one percent (61%) could not correctly subtract 19 from 36.

$^{\phi}$2. Seventy-five percent (75%) could not correctly multiply 9 times 38.

$^{\phi}$3. Seventy-four percent (74%) could not divide 125 by 5.

$^{\phi}$4. Eighty-six percent (86%) could not identify the term "degree," as it applies to the size of an angle.

$^{\theta}$5. Seventy-four percent (74%) could not identify the number of quarts in a gallon.

$^{\theta}$6. Ninety percent (90%) could not convert $4\frac{7}{5}$ to $9\frac{2}{5}$.

$^{\theta}$7. Sixty-eight percent (68%) could not pick the correct numbers to add in order to check the following subtraction: 315-179 = 136.

$^{\phi}$Overlap item, 9-, 13-, and 17-year-olds.

$^{\theta}$Overlap item, 9- and 13-year-olds.

[θ]8. Sixty-nine percent (69%) could not solve a word problem involving elementary subtraction.

9. Eighty-five percent (85%) could not approximate the number of inches in a meter and sixty-three percent (63%) could not approximate the number of centimeters in two inches.

10. Many could not identify the terms "right angle" (63%), "rectangle" (47%), "parallel" (54%), and "diameter" (81%).

[θ]Overlap item, 9- and 13-year-olds.

Figure 14

13-YEAR-OLD MATHEMATICS PERFORMANCE

A. Strengths

[φ]1. Ninety-three percent (93%) of 13-year-olds could correctly add 19 plus 38.

[φ]2. Eighty-three percent (83%) could correctly subtract 9 from 36.

[φ]3. Eighty-three percent (83%) could correctly multiply 9 times 38.

[φ]4. Eighty-seven percent (87%) could correctly divide 125 by 5.

[φ]5. Seventy-two percent (72%) could use a ruler to measure inches; and sixty-nine percent (69%) could use a ruler to measure centimeters.

[φ]6. Eighty-seven percent (87%) could add a column of four monetary sums.

[φ]7. Fifty-four percent (54%) could identify the term "degree," as it applies to the size of an angle.

[φ]Overlap item, 9-, 13-, and 17-year-olds.

[θ]8. Ninety-seven percent (97%) could identify the greater of two whole numbers.

[θ]9. Ninety-seven percent (97%) understand the function of zero in addition; ninety-four percent (94%) understand the function of zero in multiplication; and eighty-seven percent (87%) understand the function of zero in subtraction.

[θ]10. Eighty-six percent (86%) could identify the place value of hundreds, tens, and ones.

[θ]11. Seventy percent (70%) could identify the number of quarts in a gallon.

[θ]12. Fifty-four percent (54%) could convert $47/5$ to $9\ 2/5$.

[θ]13. Sixty-nine percent (69%) could pick the correct number to add in order to check the following subtraction: 315-179=136.

[θ]14. Fifty percent (50%) could solve a word problem involving elementary subtraction.

15. Eighty-five percent (85%) could add negative numbers.

16. Eighty-two percent (82%) could read simple line graphs.

[μ]17. Fifty-one percent (51%) could identify a prime number.

[μ]18. Eighty-five percent (85%) could correctly add (-5) + (-9).

[θ]Overlap item, 9- and 13-year-olds.

[μ]Overlap item, 13- and 17-year-olds.

B. Weaknesses

[μ]1. Fifty-seven percent (57%) could not identify the formula for finding the perimeter of a rectangle.

[μ]2. Ninety-one percent (91%) could not plot the equation x=y on an X-Y axis.

[μ]3. Eighty-three percent (83%) could not identify the most economical size of a product.

[μ]4. Fifty-six percent (56%) could not apply the associative property of addition.

[μ]5. Seventy-seven percent (77%) could not compute one angle of a triangle given the degree measurements of the two other angles.

[μ]6. Eighty percent (80%) could not compute the permutations of the number three.

[μ]7. Eighty-five percent (85%) could not pick the correct table containing solutions of the equation $2x + 3y = 12$.

[μ]8. Eighty-one percent (81%) could not compute 70% of 4,200.

[μ]9. Eighty-nine percent (89%) could not compute the area of a square, given its perimeter.

[μ]10. Sixty-six percent (66%) could not pick the smallest of four decimal numbers.

[μ] Overlap item, 13- and 17-year-olds.

[μ]11. Eighty-seven percent (87%) could not convert feet to meters; and eighty-three percent (83%) could not convert miles to kilometers.

[μ]12. Eighty-nine percent (89%) could not pick the fraction closest to $^{3}/_{16}$.

[μ]13. Eighty-eight percent (88%) could not pick the fractional equivalent of .333...

[μ]14. Fifty-seven percent (57%) could not compute the value of 4^3.

[μ]15. Eighty-six percent (86%) do not know the value of 3°.

[μ]16. Seventy-two percent (72%) could not solve the equation $3x - 3 = 12$.

17. Seventy-five percent (75%) display an ignorance of the functions of sets and subsets.

18. Eighty-one percent (81%) cannot interpolate from simple graphs.

[μ] Overlap item, 13- and 17-year-olds.

Figure 15

17-YEAR-OLD MATHEMATICS PERFORMANCE

A. Strengths

$^{\phi}$1. Ninety-six percent (96%) of 17-year-olds could correctly add 19 plus 38.

$^{\phi}$2. Ninety percent (90%) could correctly subtract 19 from 36.

$^{\phi}$3. Ninety-one percent (91%) could correctly multiply 9 times 36.

$^{\phi}$4. Ninety-five percent (95%) could correctly divide 125 by 5.

$^{\phi}$5. Eighty-six percent (86%) could use a ruler to measure inches; and eighty-six percent (86%) could use a ruler to measure centimeters.

$^{\phi}$6. Ninety percent (90%) could add a column of four monetary sums.

$^{\phi}$7. Seventy-five percent (75%) could identify the term "degree," as it applies to the size of an angle.

$^{\mu}$8. Sixty-seven percent (67%) could identify a prime number.

$^{\mu}$9. Ninety percent (90%) could add (-5) + (-9).

$^{\phi}$Overlap item, 9-, 13-, and 17-year-olds.

$^{\mu}$Overlap item, 13- and 17-year-olds.

$^{\mu}$10. Sixty-eight percent (68%) could identify the formula for solving the perimeter of a rectangle.

$^{\mu}$11. Sixty-eight percent (68%) could apply the associative property of addition.

$^{\mu}$12. Fifty-two percent (52%) could compute one angle of a triangle, given the degree measurements of the other two angles.

$^{\mu}$13. Sixty-two percent (62%) could pick the smallest of four decimal numbers.

$^{\mu}$14. Seventy-three percent (73%) know the value of 4^3.

$^{\mu}$15. Seventy percent (70%) could solve the equation $3x - 3 = 12$.

16. Fifty percent (50%) could compute simple interest.

17. Sixty-one percent (61%) understand basic probability theory in reference to a tossed coin.

B. Weaknesses

$^{\mu}$1. Sixty-seven percent (67%) could not plot the equation x=y on an X-Y axis.

$^{\mu}$2. Seventy-seven percent (77%) could not identify the most economical size of a product.

$^{\mu}$Overlap item, 13- and 17-year-olds.

[4]3. Sixty-four percent (64%) could not compute the permutations of the number three.

[4]4. Seventy-four percent (74%) could not pick the correct table containing solutions of the equation $2x + 3y = 12$.

[4]5. Fifty-four percent (54%) could not compute 70% of 4,200.

[4]6. Eighty-two percent (82%) could not compute the area of a square, given its perimeter.

[4]7. Seventy-one percent (71%) could not convert feet to meters; and sixty-nine percent (69%) could not convert miles to kilometers.

[4]8. Seventy-five percent (75%) could not pick the fraction closest to 3/16.

[4]9. Fifty-eight percent (58%) could not pick the fractional equivalent of .333...

[4]10. Seventy-seven percent (77%) do not know the value of 3^0.

11. Fifty-three percent (53%) could not compute distance using the scale on a map.

12. Fifty-five percent (55%) could not compute parking charges, given rate and time.

13. Seventy percent (70%) could not interpolate from simple graphs.

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[4]Overlap item, 13- and 17-year-olds.

Cognitive progress, or lack of it, is heavily influenced by attitudinal factors. Seventeen-year-olds were queried about their perception of mathematics and its value. Considering the results cited above, it is remarkable that a total of 86 percent responded highly or somewhat favorably to the question, "Do you like mathematics?" Nearly all students (93%) often or sometimes use mathematics outside of the classroom. Sixty-seven percent of the 17-year-olds maintain that they "almost always" finish their math assignments, although only 40 percent "almost always" check their answers. Difficulties with the metric system enumerated above are explained by the fact that 35 percent of the respondents have not been taught metrication (two percent more were unsure if they had received instruction or not!). Of those who were taught the basics of the metric system, only 40 percent received their knowledge in math class.

CHAPTER III

THE MATHEMATICS ASSESSMENT: CONCLUSIONS AND RECOMMENDATIONS

Before embarking on a reiteration of the most significant needs unearthed by the mathematics assessment, and recommendations for their alleviation, a qualification should be made. The assessment revealed a large body of data dealing with performance, at various ages, for various regions, communities, and school sizes. Therefore, this publication's title should be taken quite literally. It attempts, not to analyze exhaustively, but merely to highlight. More intensive research of these findings in conjunction with previous assessments and information gleaned from analogous public and private sources, could only increase our understanding of the accomplishments and needs of our school-age children.

First the good news. Contrary to the doomsayers' warnings, we are not graduating wholesale lots of students who have failed to master basic skills. Our children's abilities, though inferior to the national mean, extend well beyond simple addition, multiplication, subtraction, and division. Still, some alarming facts emerge.

Briefly stated, what were the most striking deficiencies revealed by the mathematics assessment? Certainly, the failure to instill logical reasoning abilities as an adjunct to mathematical proficiency (Figures 6, 7, 8, Objective V) must rate high on the list. No less significant is the appalling failure of students in certain content areas, specifically metrication and consumer math. Attitudinal problems also emerge, as the 17-year-old survey reveals. If nearly 14 percent actually dislike mathematics, and 7 percent "almost never" use mathematics skills outside of school, we are failing to provide a number of children with the means and incentive to survive in the consumer and employment arenas.

A more complex issue involves the large regional variation within the state. Since state funding provides 58 percent of the financial burden of education, one might expect more uniform statewide accomplishment. Yet, regional variations are large and consistent for all age groups.

The statistical accuracy which pinpoints problems simply cannot be expected in revealing their cause. Several suggestions can be advanced, however. Teachers instruct mathematics; therefore one expects adequate preparation of teachers in this field. But, Louisiana certification requirements specify only six semester hours of mathematics for elementary teachers. Worse,

many colleges offer mathematics courses specifically designed for education majors, courses whose rigor and depth might be challenged.

Just as teachers must meet only the most modest requirements, so, too, are high school students required to take only two years of mathematics. Any course, from remedial math to calculus satisfies this requirement. To put it mildly, the diversity of courses is enormous, and any course meets the requirements for graduation.

But, as has been emphasized repeatedly, school achievement depends on more than teachers and courses. As the community figures emphasize (Figures 10, 11, 12) suburban students, who are usually middle class, perform better than rural or city children. This reinforces the connection between socio-economic status and learning, a connection which is peripheral to direct action by the school system.

The deficiencies have been documented; some of the causes suggested. The next question follows logically--what specific actions can be taken to remedy Louisiana students' mathematic difficulties? Equally important, how can we assess the effectiveness of that remedy? The Mathematics Assessment Advisory Council has prepared specific suggestions for action at each age

level, based on assessment results. Their recommendations follow, in Figure 16. After they are implemented, a re-assessment should reveal progress in mathematics which, it is hoped, will contribute to the competency and self-sufficiency of Louisiana's children.

Figure 16

Mathematics Assessment Advisory Council

RECOMMENDATIONS

9-Year-Old

1. Greater emphasis should be placed on:
   - A. Fractions (concrete and semi-concrete).
   - B. Operations with zero.
   - C. Carrying-borrowing.
   - D. Awareness of operational symbols, vocabulary of operations.
   - E. Word names to coin value.
   - F. Metric system.
   - G. Time concept (clock, calendar).
   - H. Recognition of geometric figures.
   - I. Formal instruction in problem solving (reading, listening skills; children writing own problems).
2. Each system should initiate its own assessment based on the state assessment.
3. Data gathered by state assessment should be used to upgrade mathematics program.
4. Each local system should establish basic minimum essentials/competencies in a spiraling program with

checkpoints at primary, intermediate, and junior high levels (based on local structure).

5. Based on needs established by state assessment, the following areas need to be stressed in mathematics inservice instruction:
   A. Formal problem-solving techniques.
   B. Metric system.
   C. Fraction concepts.
   D. Time.
   E. Arithmetic computation.
   F. Vocabulary/recognition of basic geometric shapes.
6. Teacher-training instructions should train pre-service elementary teachers in methods for teaching arithmetic with emphasis on construction and use of manipulative materials to be used in learning.

13-Year-Old

1. Greater emphasis should be given to metrication.
2. Unsatisfactory areas which must be improved are:
   A. Recognizing and applying fractions.
   B. Ordering fractions.
   C. Manipulating fractions.
   D. Translating verbal problems in language of mathematics.

E. Reading and interpreting graphs.

F. Algebraic concepts.

G. Converting from one unit of measure to another; unit of measurement: the degree.

2. Develop local level needs assessment; conduct periodic reviews and follow-up.

3. Local systems should analyze programs of instruction in mathematics in light of needs assessment results.

4. Appropriate inservice training programs for improvement in problem areas should be set up.

5. Regional workshops to disseminate, interpret, and offer suggestions regarding assessment should be held and means of utilizing results should be suggested (the State should provide consultant services to local systems and the teacher training institutions should be involved in this effort).

6. Teacher training institutions should evaluate mathematics curricula for potential teachers to see if they are providing competencies that will be useful to teachers.

7. Consideration should be given to strengthening certification requirements of elementary and junior high school teachers.

17-Year-Old

1. Greater emphasis should be placed on teaching metrication in mathematics classes (only 40 percent reported having been taught the metric system in math--others were taught in science classes; only 63 percent were taught the metric system).
2. Criteria should be established at each grade level by each local school system and these minimal competencies should be achieved. The levels of expectancy should be realistic and carefully explored to encourage the low achiever in mathematics. Students who take advanced mathematics show the greatest increase in correct responses between ages 13 and 17 on the majority of items. Non-achieving students are lowering average achievement. Little is done for weaker pupils; data suggest little gain for slower pupils as they progress from ages 13 to 17.
3. Minimum competencies should be established at the end of the eighth grade. These will determine the future of the math curriculum. Two expectancy levels should be set:

A. For those showing success in algebra I.

B. For those with low achievement in general math.

4. More emphasis should be given to interpretive process of problem solving.

5. The general mathematics curriculum should be re-evaluated (the purpose of this is in line with recommendations 2 and 3 above).

6. Re-evaluate mathematics efforts in Title I ESEA (to improve program for low achievers).

7. Teacher training institutions should evaluate mathematics curricula for potential teachers to see if they are providing competencies that will be useful to teachers.

8. More mathematics specialists should be employed at state level.

Appendix 1

MATHEMATICS ASSESSMENT ADVISORY COUNCIL MEMBERSHIP

NAME	AFFILIATION	AGE GROUP
Dr. Bennie Adams	Acting Chairman, Mathematics Department Southern University, New Orleans	17-Year-Old
Dr. Sam Adams	Professor of Education Louisiana State University	9-Year-Old
Dr. Manuel Berri	Professor of Mathematics University of New Orleans	13-Year-Old
James A. Bordelon	Teacher, Acadia Parish Schools	17-Year-Old
Mrs. Olympia Boucree	Supervisor of Mathematics Orleans Parish Schools	9-Year-Old
Curtis Brazil	Teacher, Vernon Parish Schools	17-Year-Old
John Castore	Teacher, Bossier Parish Schools	9-Year-Old
Mrs. Mary Cates	Teacher, Bossier Parish Schools	13-Year-Old
Honorable Jesse Deen	Representative, Ninth District	17-Year-Old
Ms. Carrel Martin	New Orleans area AFL-CIO	13-Year-Old
Ms. Linda Hammond	Primary Coordinator, Caddo Parish Schools	9-Year-Old

Dr. Jesse Hutchinson	Supervisor, Secondary Mathematics Rapides Parish Schools	17-Year-Old
Ms. Della Roberts	Teacher, Pointe Coupee Parish Schools	9-Year-Old
Mrs. Joy Sams	Teacher, Bienville Parish Schools	17-Year-Old
Dr. William Smith	Professor of Education Louisiana State University	9-Year-Old
Ms. Ann Stone	Teacher, Monroe City Schools	9-Year-Old
Ms. Lorene Watkins	Teacher, Lafourche Parish Schools	13-Year-Old
Dr. Russell Whittington	Head, Department of Mathematics Northwestern State University	13-Year-Old
Dr. Elton Womack	State Supervisor of Mathematics State Department of Education	Consultant

ASSESSMENT STAFF

Dr. J Stuart Wilson, Director
Mrs. Rebecca S. Contois, Assistant Director
Sam C. Pernici, Supervisor
Miss Jimmie L. Steptoe, Supervisor
Stephen L. Delacroix, Supervisor

Appendix 2

MATHEMATICS ASSESSMENT TIMETABLE

Preparation

1972	Decision made to assess mathematics
Fall, 1973	LaAEP prepared goals and objectives in survey form
January, 1974	A survey was mailed to 600 mathematics teachers
February, 1974	Eighteen supervisors, teachers, and university personnel were invited to be on Mathematics Assessment Advisory Council.
March, 1974	Mathematics Advisory Council Workshop I Goals and Objectives
May, 1974	Mathematics Advisory Council Workshop II Selected Items
June, 1974	Published goals and objectives Field tested items

Administration

Fifteen thousand 9-, 13-, and 17-year-old students were assessed.

October, 1974	5,000 Thirteen-year-olds assessed
January, 1975	5,000 Nine-year-olds assessed
March, 1975	5,000 Seventeen-year-olds assessed

Analysis

November, 1974	Westinghouse Learning Corporation scored booklets.
December, 1975	Research Triangle Institute drew sample and processed data.
	Mathematics Assessment Advisory Council and Assessment staff interpreted and analyzed data.

Dissemination

April, 1975	Goals and objectives sent to parish superintendents, schools, educational institutions, organizations, public officials, and educators.
January - June, 1976	Results reports will be released, staff will assist parishes with use of information.